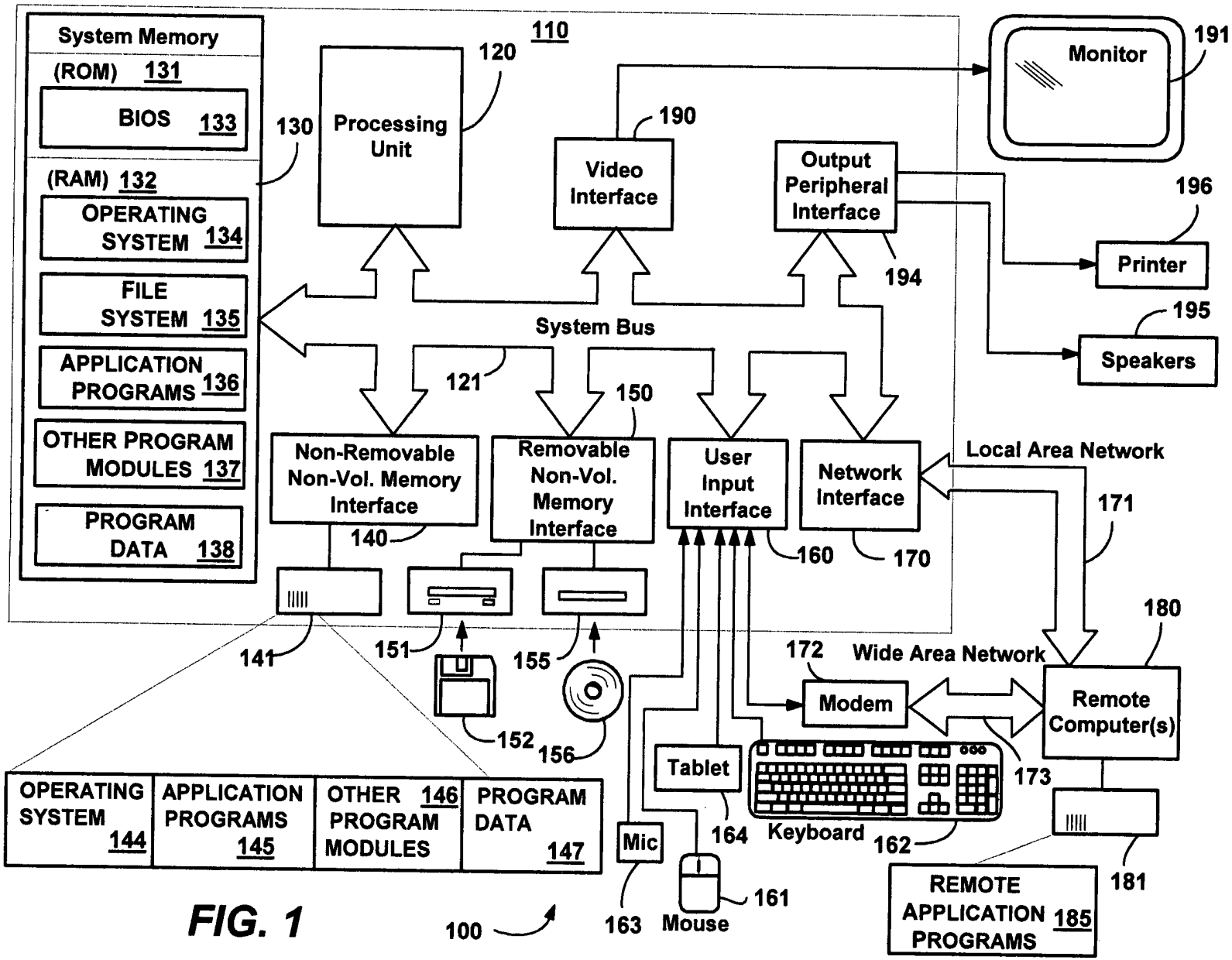
System Memory
(ROM) 131
BIOS 133
(RAM) 132
OPERATING SYSTEM 134
FILE SYSTEM 135
APPLICATION PROGRAMS 136
OTHER PROGRAM MODULES 137
PROGRAM DATA 138
130
110
Processing Unit
120
Video Interface
190
Output Peripheral Interface
194
Monitor
191
Printer
196
Speakers
195
System Bus
121
150
Non-Removable Non-Vol. Memory Interface
140
Removable Non-Vol. Memory Interface
User Input Interface
160
Network Interface
170
Local Area Network
171
141
151
155
152
156
172
Wide Area Network
Modem
Remote Computer(s)
180
173
Tablet
164
Keyboard
162
Mic
163
Mouse
161
181
REMOTE APPLICATION PROGRAMS 185
OPERATING SYSTEM 144
APPLICATION PROGRAMS 145
OTHER PROGRAM MODULES 146
PROGRAM DATA 147
100

FIG. 1

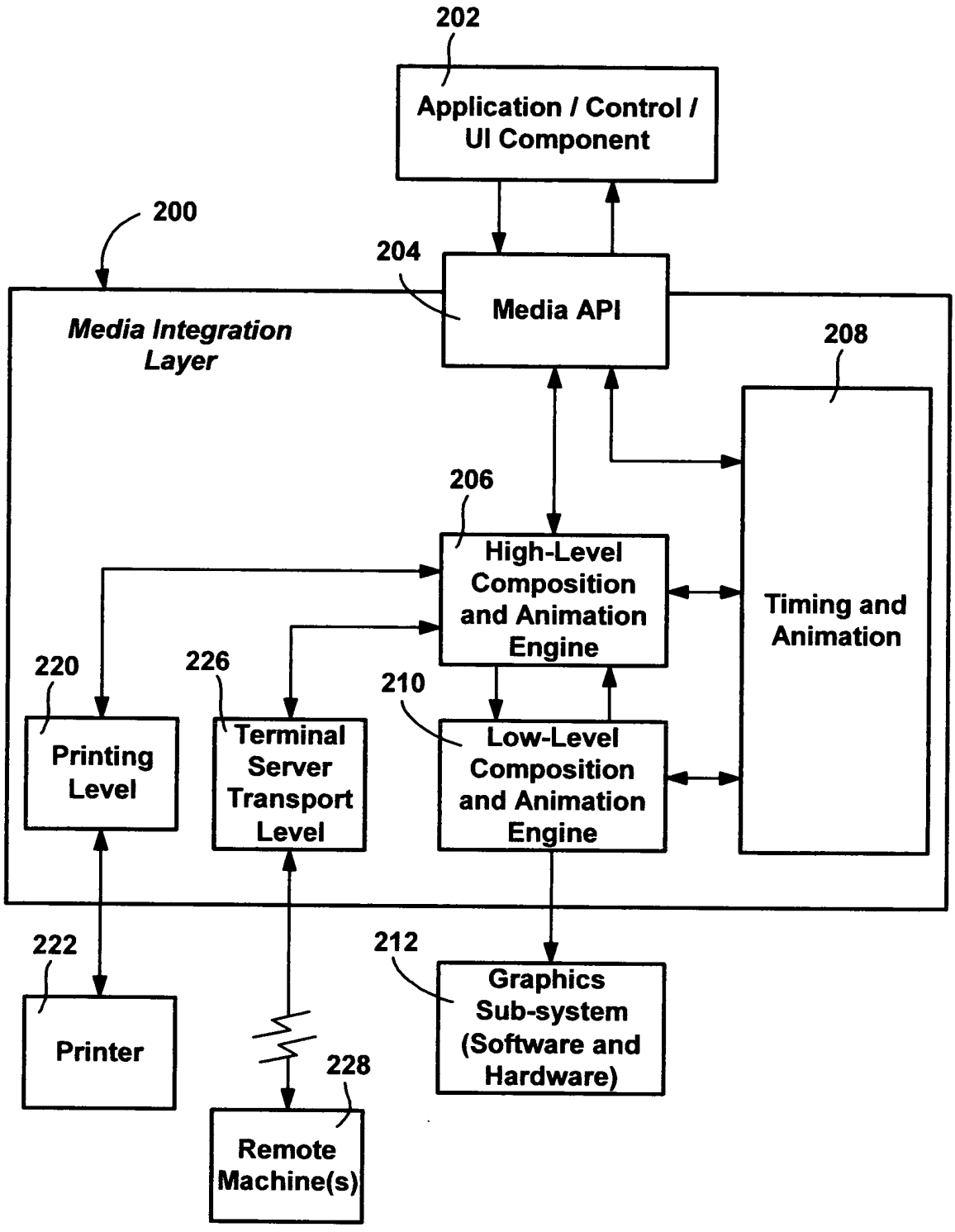
202
Application / Control / UI Component
200
204
Media API
Media Integration Layer
208
206
High-Level Composition and Animation Engine
Timing and Animation
220
226
210
Printing Level
Terminal Server Transport Level
Low-Level Composition and Animation Engine
222
212
Printer
Graphics Sub-system (Software and Hardware)
228
Remote Machine(s)

FIG. 2

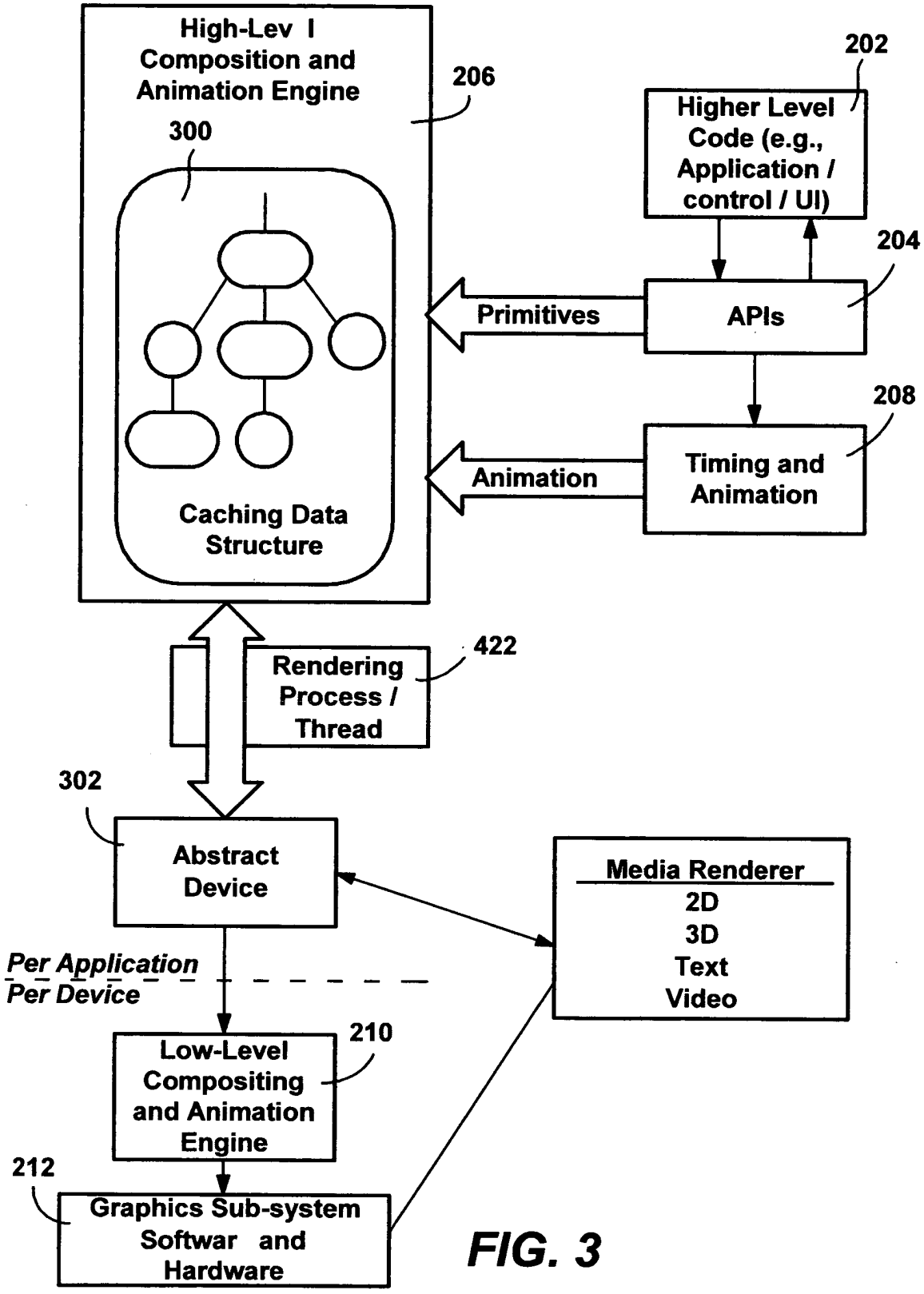
High-Lev l
Composition and
Animation Engine
206
300
Caching Data
Structure
202
Higher Level
Code (e.g.,
Application /
control / UI)
204
Primitives
APIs
208
Animation
Timing and
Animation
422
Rendering
Process /
Thread
302
Abstract
Device
Media Renderer
2D
3D
Text
Video
Per Application
Per Device
210
Low-Level
Compositing
and Animation
Engine
212
Graphics Sub-system
Softwar and
Hardware

FIG. 3

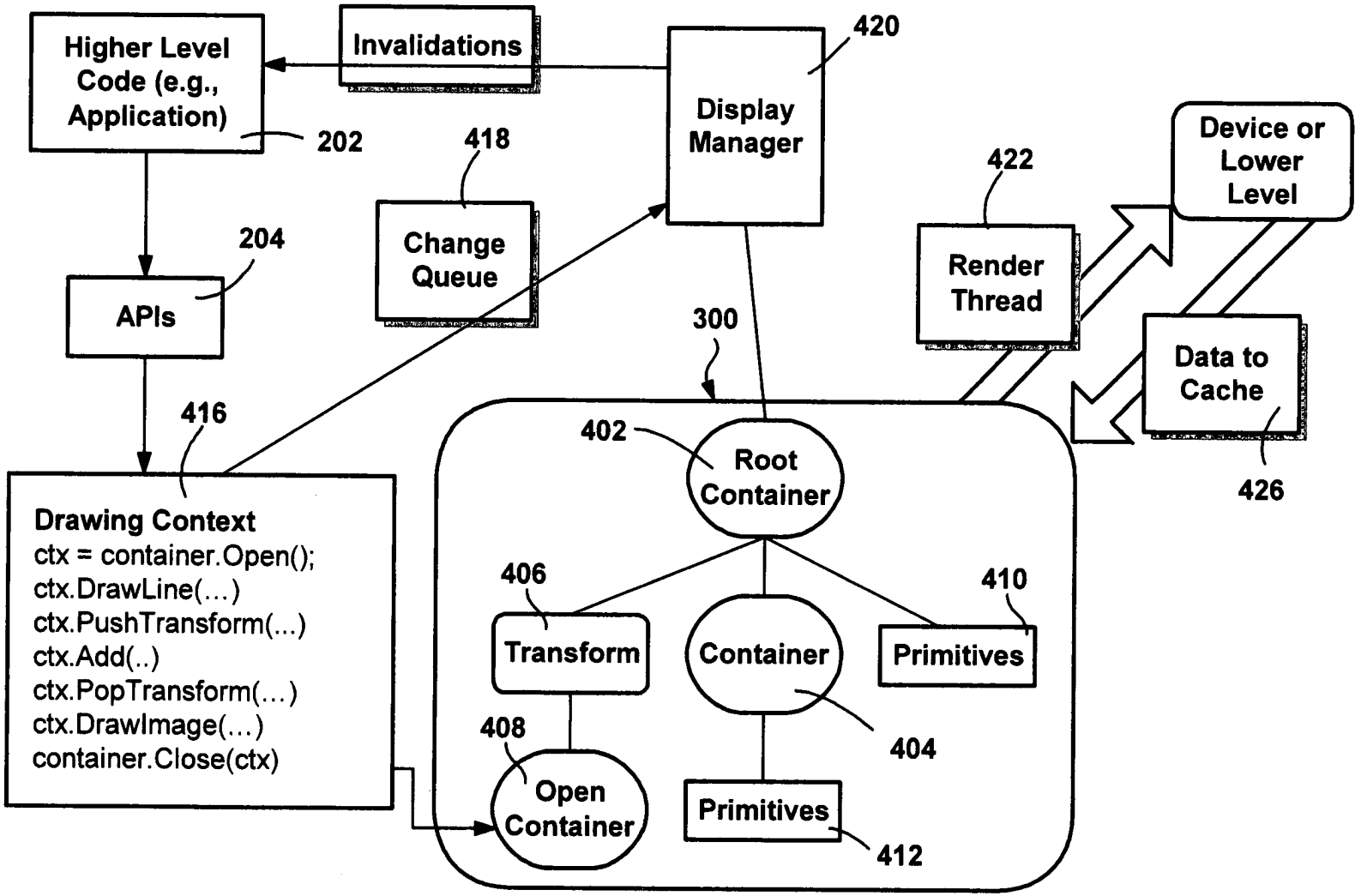
Higher Level Code (e.g., Application)
202
Invalidations
420
Display Manager
Device or Lower Level
422
418
Change Queue
Render Thread
204
APIs
300
Data to Cache
416
426
402
Root Container
Drawing Context
ctx = container.Open();
ctx.DrawLine(...)
ctx.PushTransform(...)
ctx.Add(..)
ctx.PopTransform(...)
ctx.DrawImage(...)
container.Close(ctx)
406
410
Transform
Container
Primitives
404
408
Open Container
Primitives
412

FIG. 4

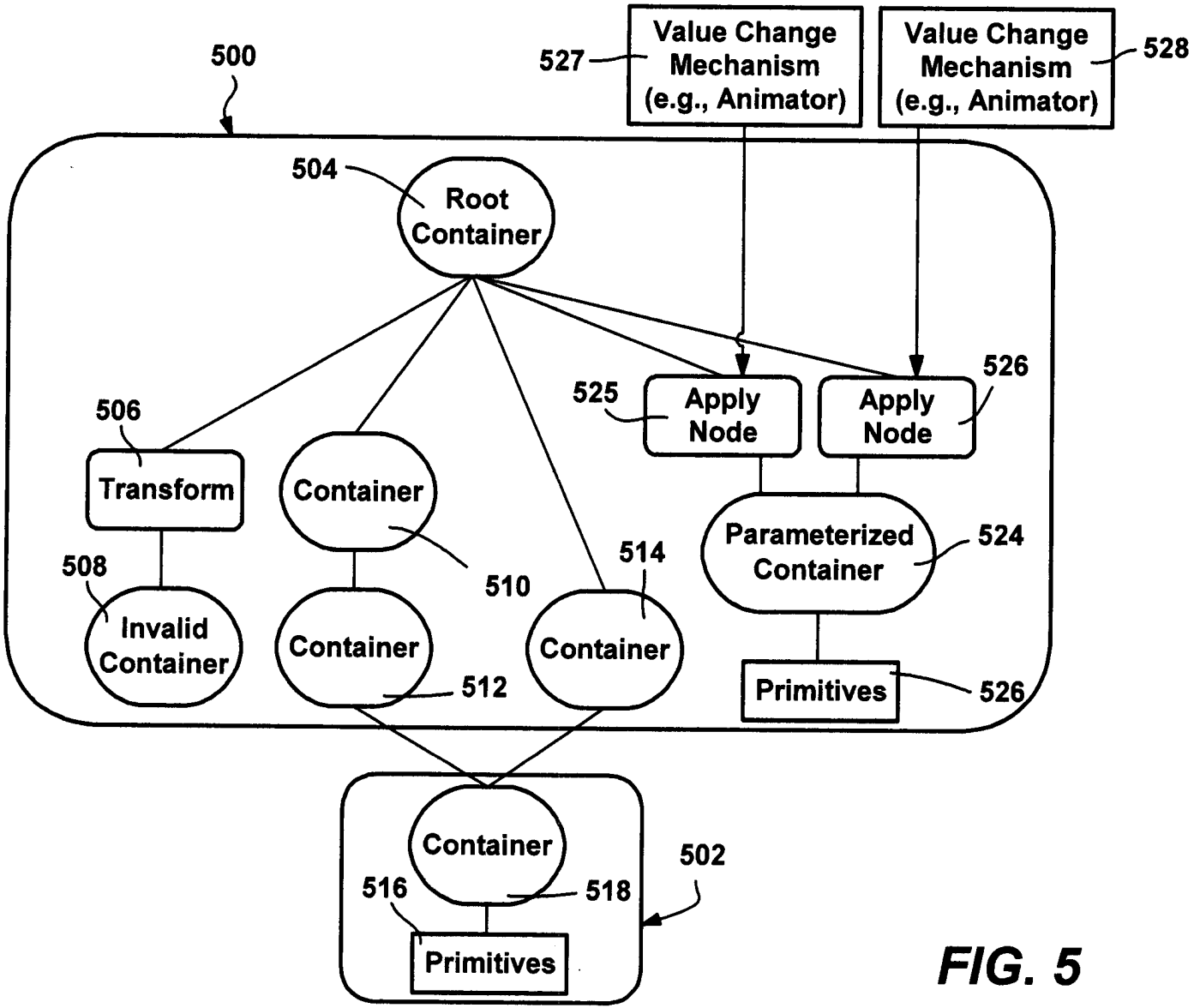
500
527
Value Change Mechanism (e.g., Animator)
528
Value Change Mechanism (e.g., Animator)
504
Root Container
506
Transform
Container
510
525
Apply Node
526
Apply Node
508
Invalid Container
Container
512
514
Container
Parameterized Container
524
Primitives
526
502
Container
516
518
Primitives

FIG. 5

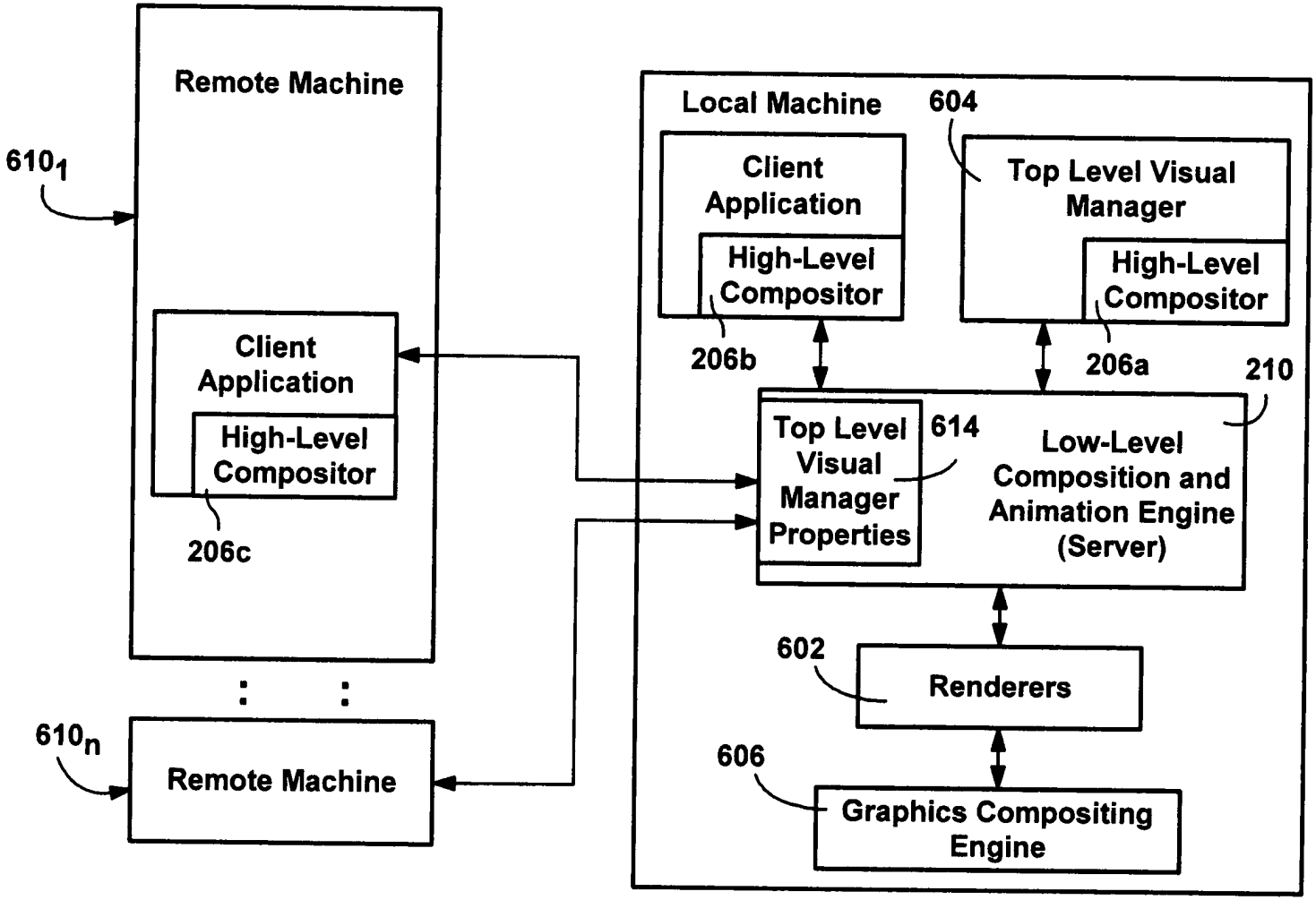
Remote Machine
610₁
Client Application
High-Level Compositor
206c
610n
Remote Machine
Local Machine
604
Client Application
High-Level Compositor
206b
Top Level Visual Manager
High-Level Compositor
206a
210
Top Level Visual Manager Properties
614
Low-Level Composition and Animation Engine (Server)
602
Renderers
606
Graphics Compositing Engine

FIG. 6

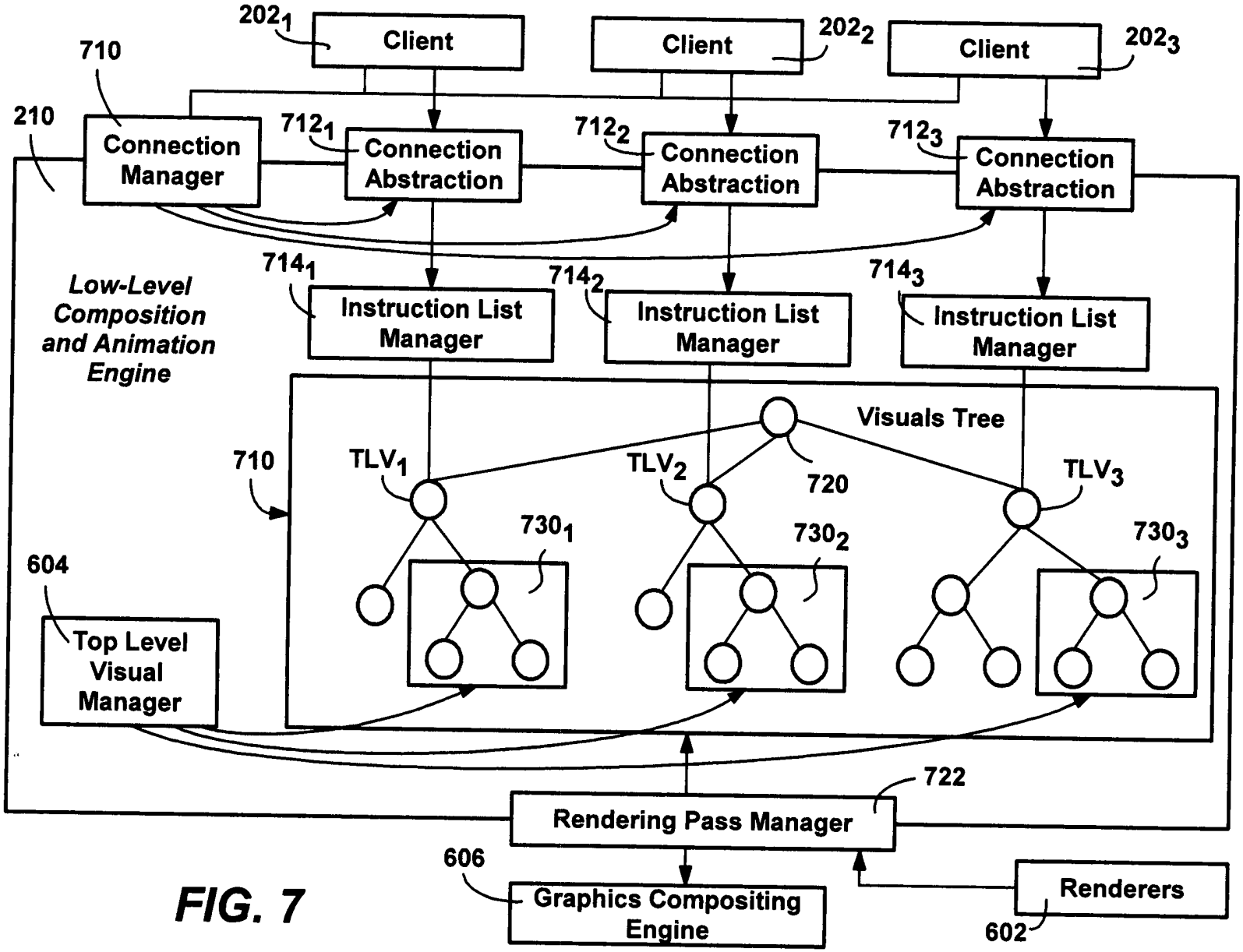
202_1
Client
Client
202_2
Client
202_3
710
210
Connection Manager
712_1
Connection Abstraction
712_2
Connection Abstraction
712_3
Connection Abstraction
Low-Level Composition and Animation Engine
714_1
Instruction List Manager
714_2
Instruction List Manager
714_3
Instruction List Manager
Visuals Tree
710
TLV_1
TLV_2
720
TLV_3
730_1
730_2
730_3
604
Top Level Visual Manager
722
Rendering Pass Manager
606
Graphics Compositing Engine
Renderers
602

FIG. 7

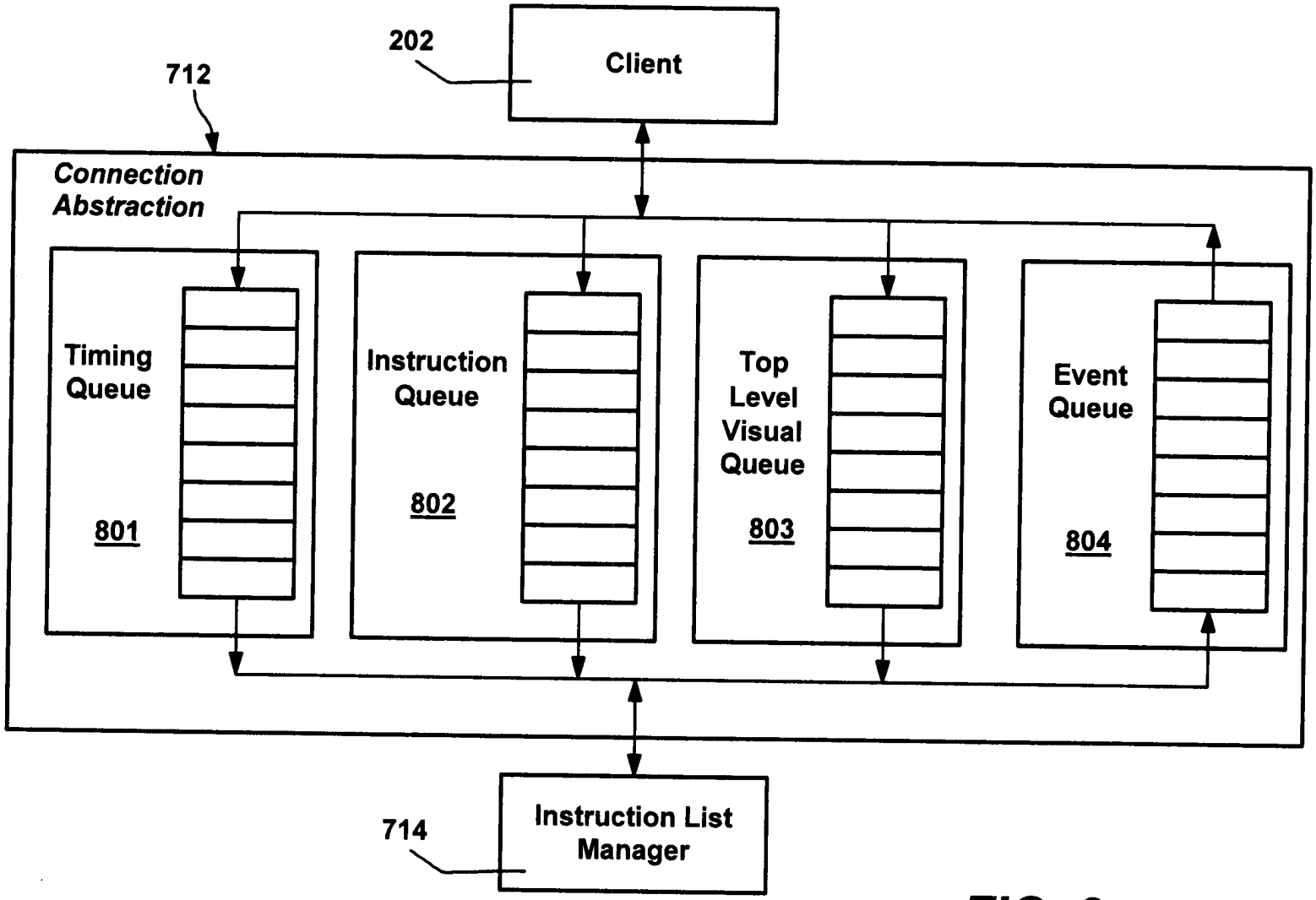
202
Client
712
Connection Abstraction
Timing Queue
801
Instruction Queue
802
Top Level Visual Queue
803
Event Queue
804
714
Instruction List Manager

FIG. 8

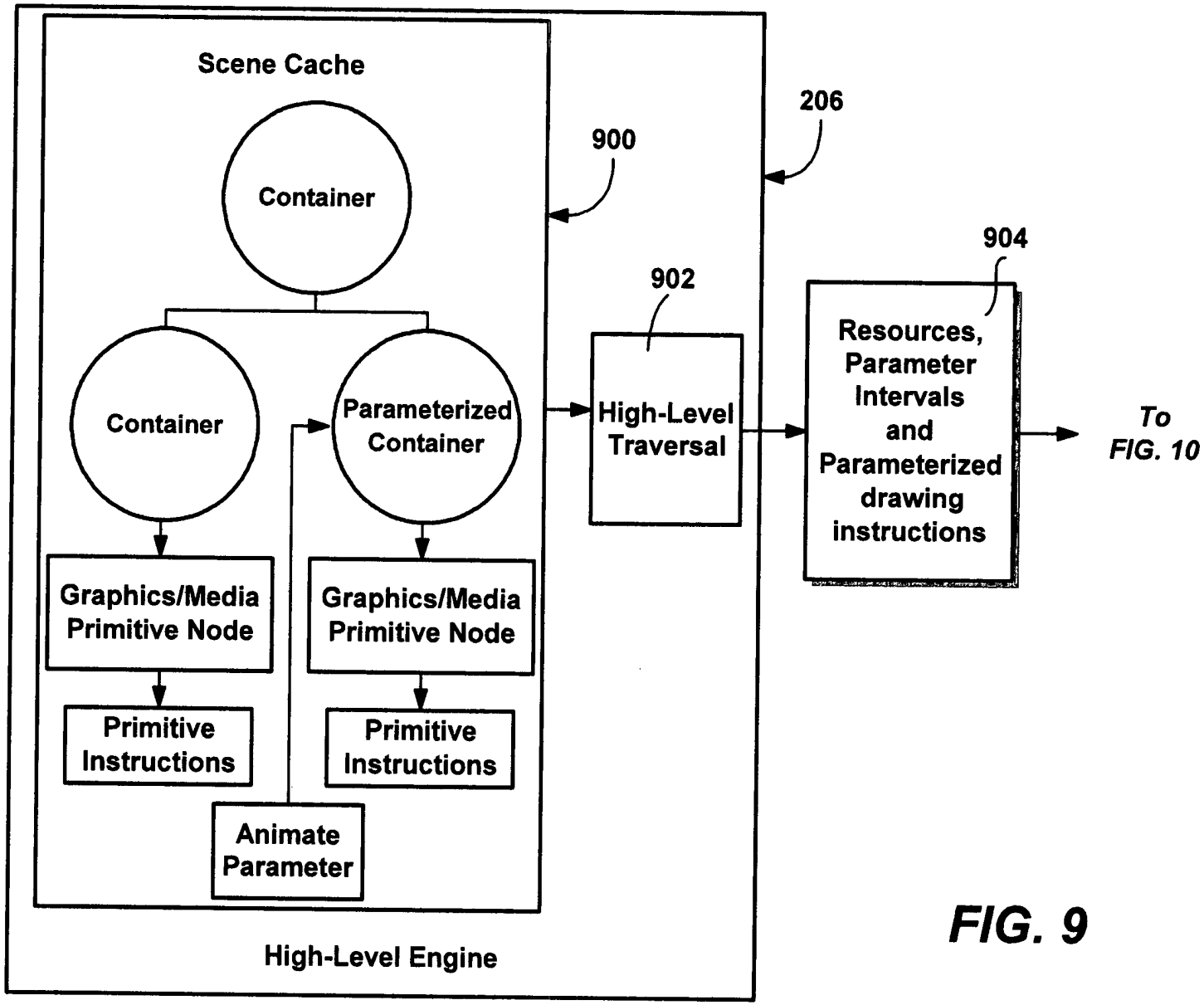
Scene Cache
Container
Container
Parameterized Container
Graphics/Media Primitive Node
Graphics/Media Primitive Node
Primitive Instructions
Primitive Instructions
Animate Parameter
High-Level Engine
900
206
902
High-Level Traversal
904
Resources, Parameter Intervals and Parameterized drawing instructions
To FIG. 10

FIG. 9

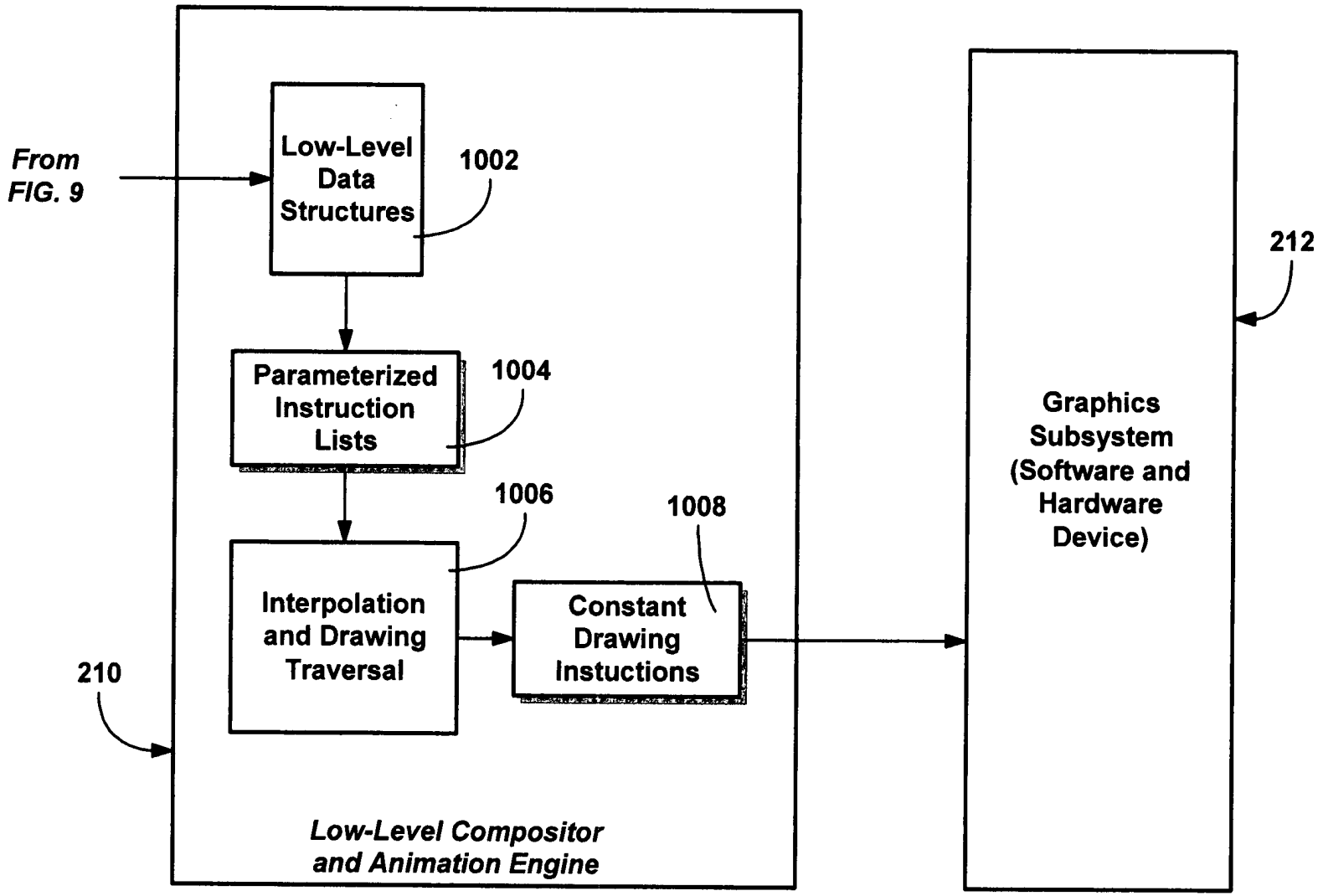
From FIG. 9
Low-Level Data Structures
1002
Parameterized Instruction Lists
1004
1006
1008
Interpolation and Drawing Traversal
Constant Drawing Instuctions
210
Low-Level Compositor and Animation Engine
Graphics Subsystem (Software and Hardware Device)
212

FIG. 10

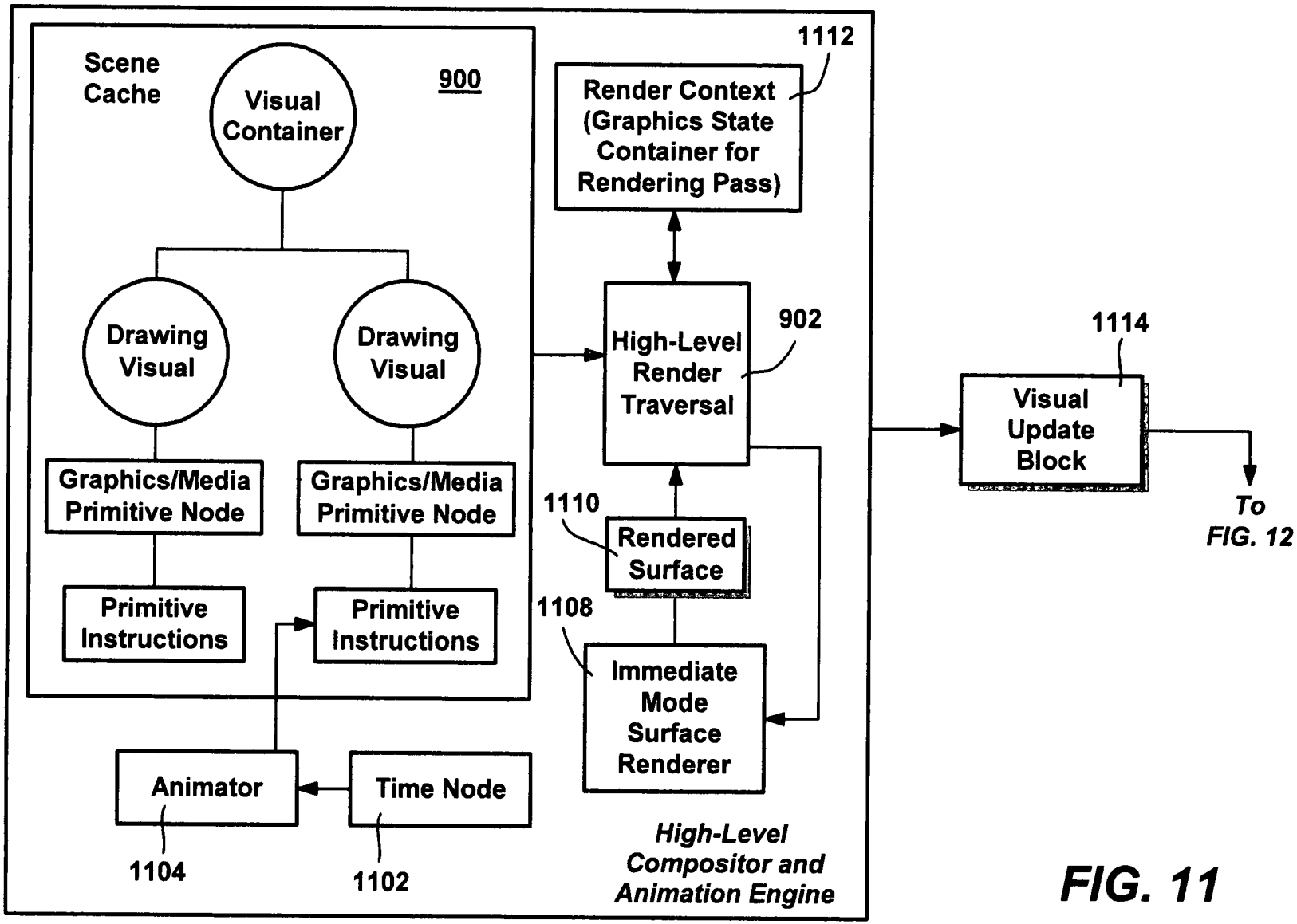
Scene Cache
900
Visual Container
Drawing Visual
Drawing Visual
Graphics/Media Primitive Node
Graphics/Media Primitive Node
Primitive Instructions
Primitive Instructions
Animator
Time Node
1104
1102
1112
Render Context (Graphics State Container for Rendering Pass)
High-Level Render Traversal
902
1110
Rendered Surface
1108
Immediate Mode Surface Renderer
High-Level Compositor and Animation Engine
1114
Visual Update Block
To FIG. 12

FIG. 11

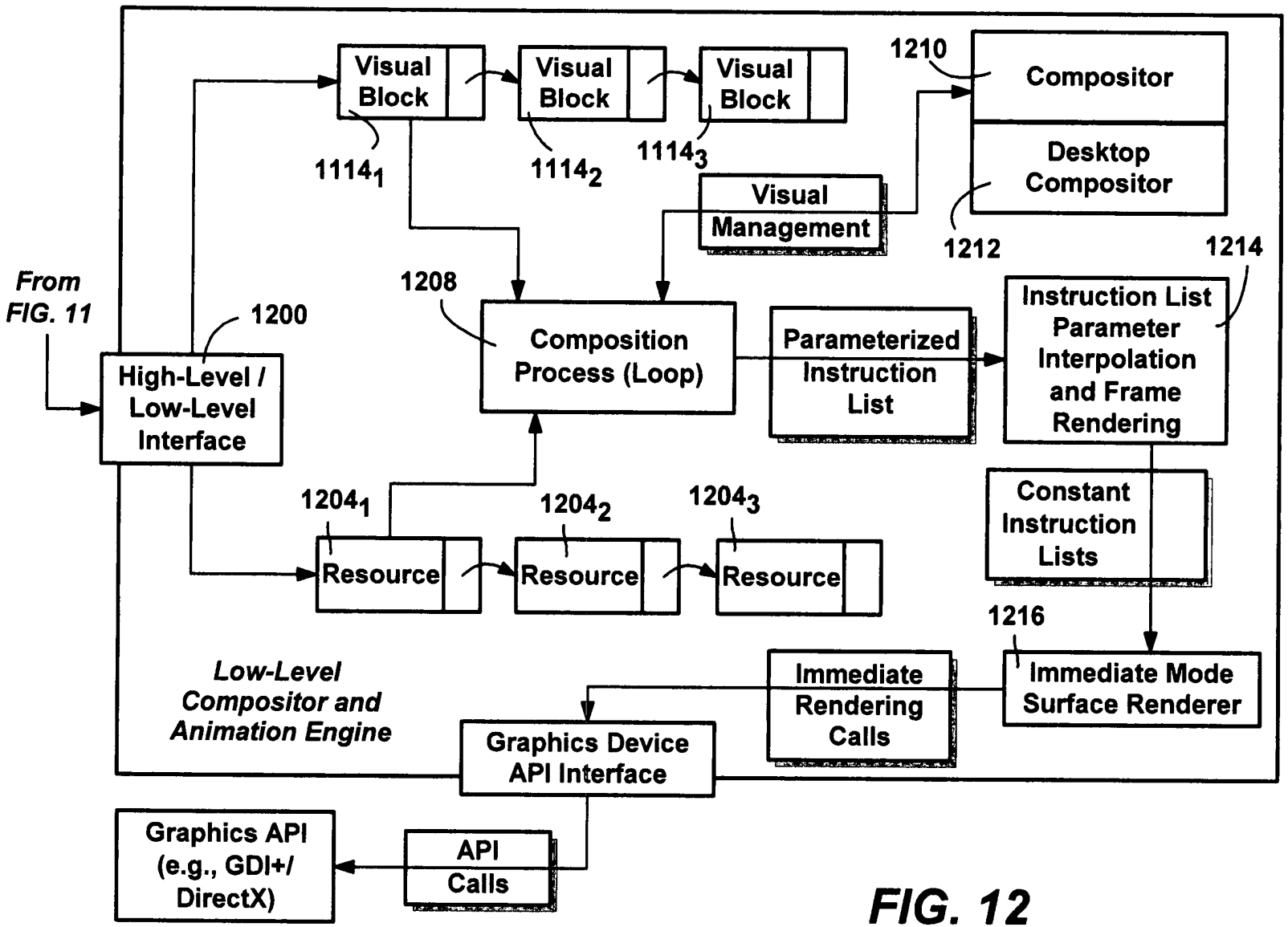
From FIG. 11
1200
High-Level / Low-Level Interface
Visual Block
Visual Block
Visual Block
1114₁
1114₂
1114₃
1210
Compositor
Desktop Compositor
1212
Visual Management
1208
Composition Process (Loop)
Parameterized Instruction List
Instruction List Parameter Interpolation and Frame Rendering
1214
Constant Instruction Lists
1204₁
1204₂
1204₃
Resource
Resource
Resource
1216
Immediate Rendering Calls
Immediate Mode Surface Renderer
Low-Level Compositor and Animation Engine
Graphics Device API Interface
Graphics API (e.g., GDI+/ DirectX)
API Calls

FIG. 12

1300

Instructions				
Instruction ID	Flags	Size	Fized Size Data	Variable Size Data
SetMatrix	Flags	Size	3x3 Matrix	N/A
DrawGlyphs	Flags	Size	Glyph Count	Glyph Handles
DrawPath	Flags	Size	N/A	Brush, Pen, Path
DrawVideo	Flags	Size	Video Resource Handle	N/A
DrawImage	Flags	Size	Image Resource Handle	N/A
DrawRect	Flags	Size	Rect Coordinates	Brush, Pen
PushAlpha	Flags	Size	Bounding Box	N/A
PopAlpha	Flags	Size	Alpha	N/A
SetOffset	Flags	Size	Vector 2D	N/A

FIG. 13

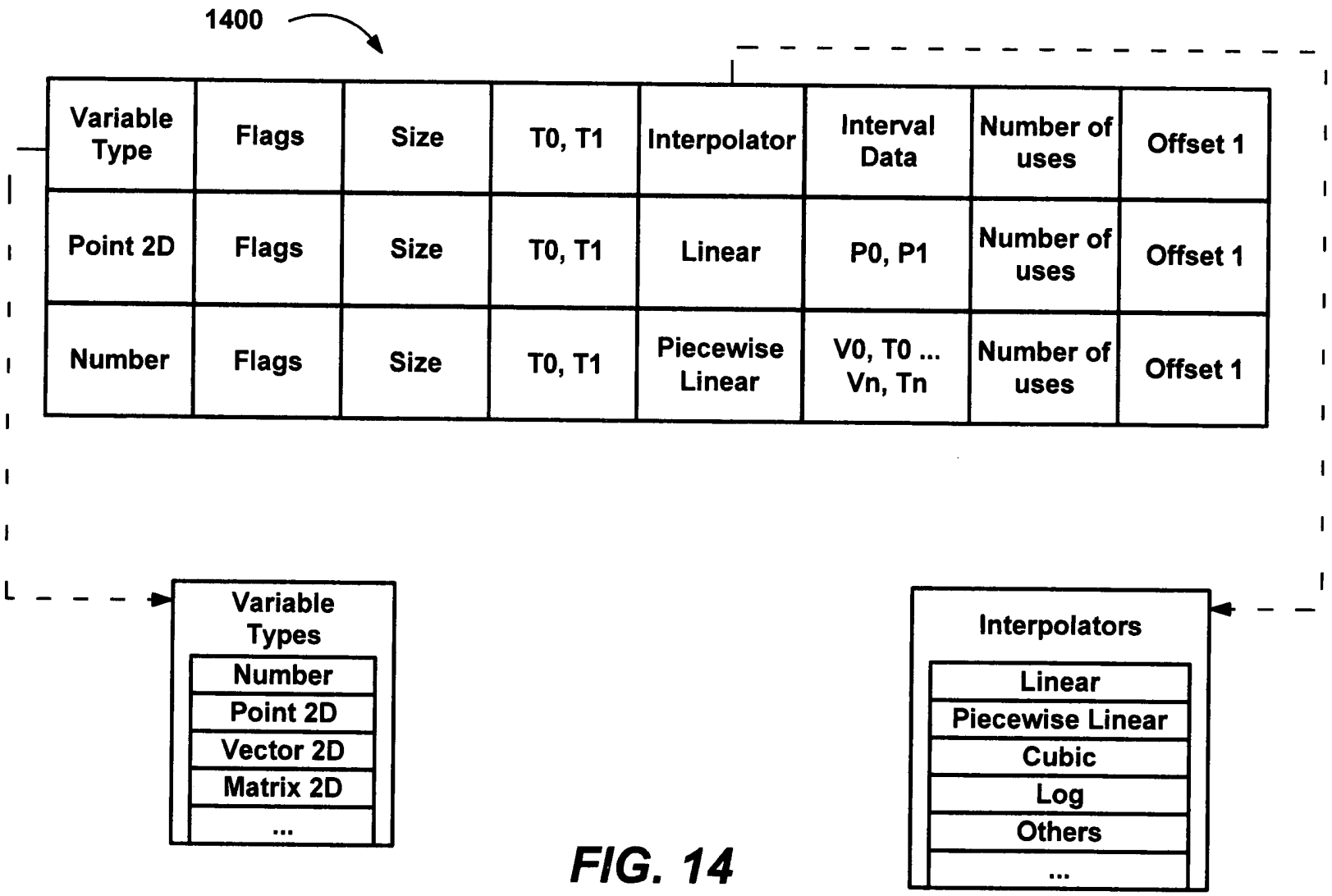
1400
Variable Type
Flags
Size
T0, T1
Interpolator
Interval Data
Number of uses
Offset 1
Point 2D
Flags
Size
T0, T1
Linear
P0, P1
Number of uses
Offset 1
Number
Flags
Size
T0, T1
Piecewise Linear
V0, T0 ... Vn, Tn
Number of uses
Offset 1
Variable Types
Number
Point 2D
Vector 2D
Matrix 2D
...
Interpolators
Linear
Piecewise Linear
Cubic
Log
Others
...

FIG. 14

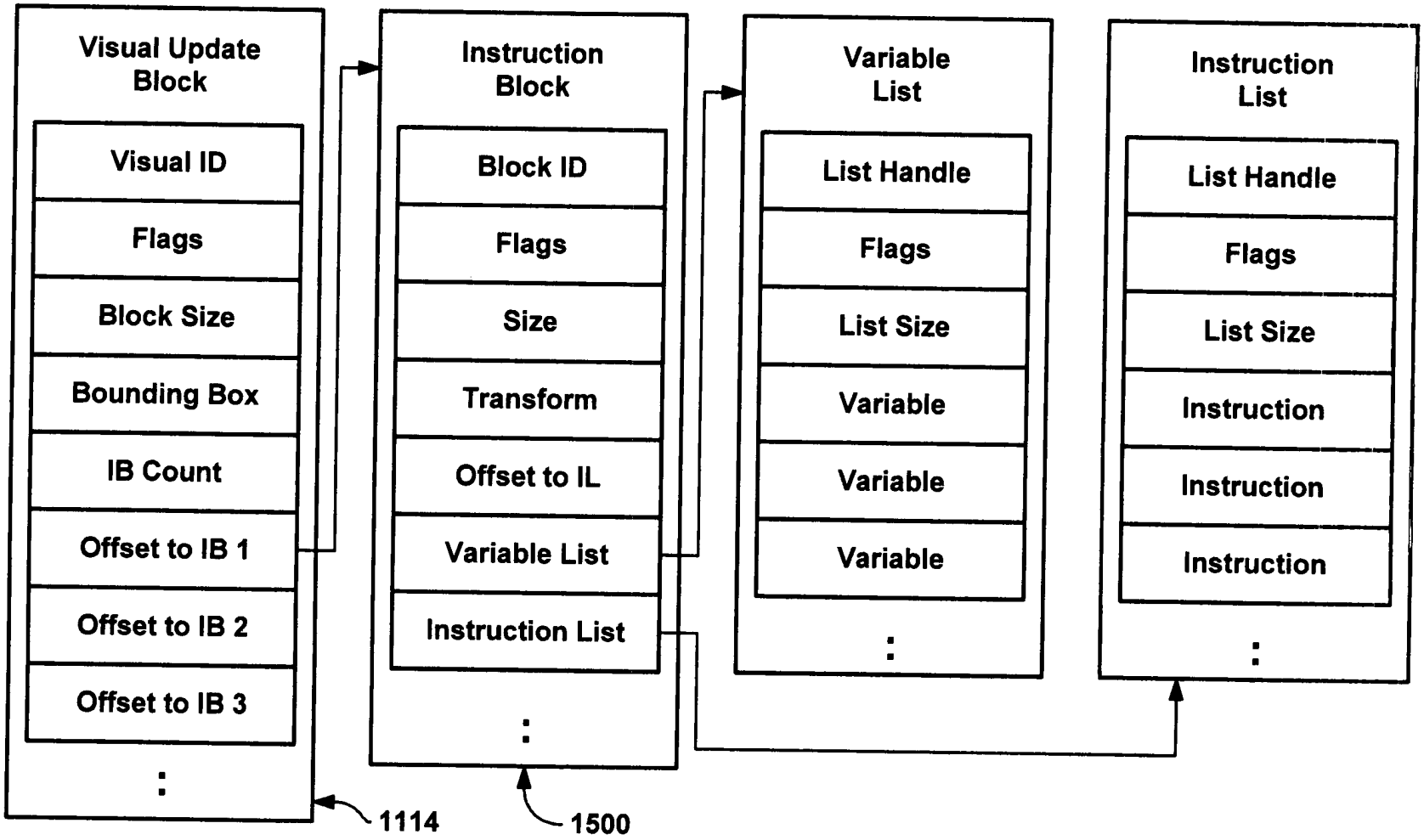
Visual Update Block
Visual ID
Flags
Block Size
Bounding Box
IB Count
Offset to IB 1
Offset to IB 2
Offset to IB 3
Instruction Block
Block ID
Flags
Size
Transform
Offset to IL
Variable List
Instruction List
Variable List
List Handle
Flags
List Size
Variable
Variable
Variable
Instruction List
List Handle
Flags
List Size
Instruction
Instruction
Instruction
1114
1500

FIG. 15

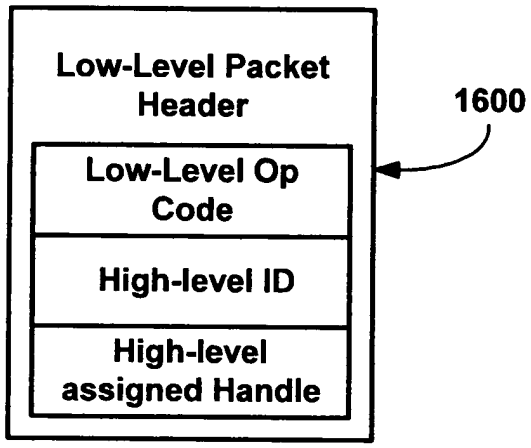
Low-Level Packet Header
1600
Low-Level Op Code
High-level ID
High-level assigned Handle

FIG. 16

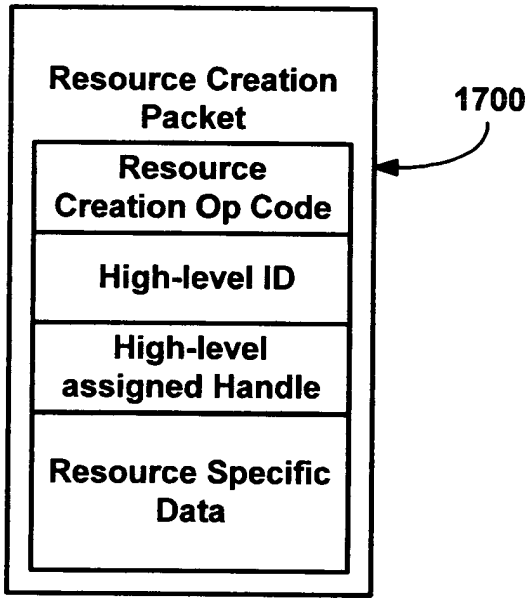
Resource Creation Packet
1700
Resource Creation Op Code
High-level ID
High-level assigned Handle
Resource Specific Data

FIG. 17

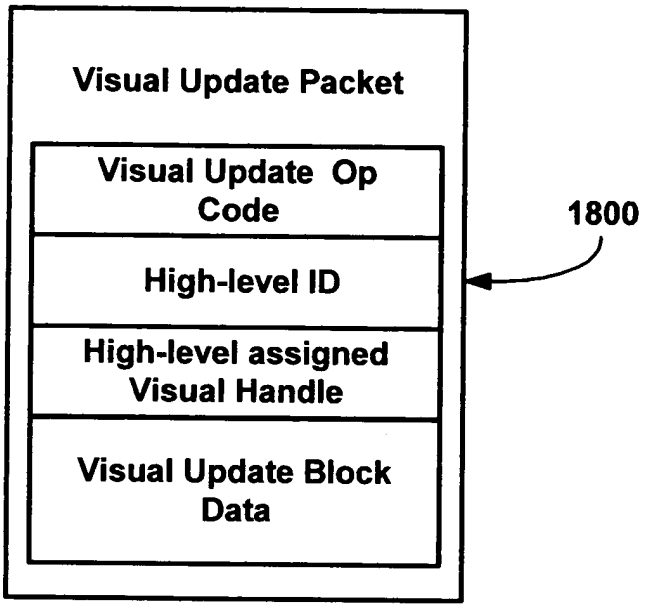
Visual Update Packet
Visual Update Op Code
High-level ID
High-level assigned Visual Handle
Visual Update Block Data
1800

FIG. 18

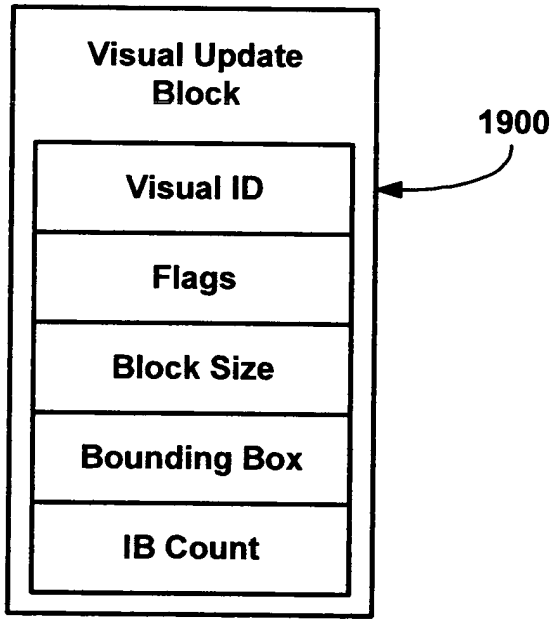
Visual Update Block
Visual ID
Flags
Block Size
Bounding Box
IB Count
1900

FIG. 19

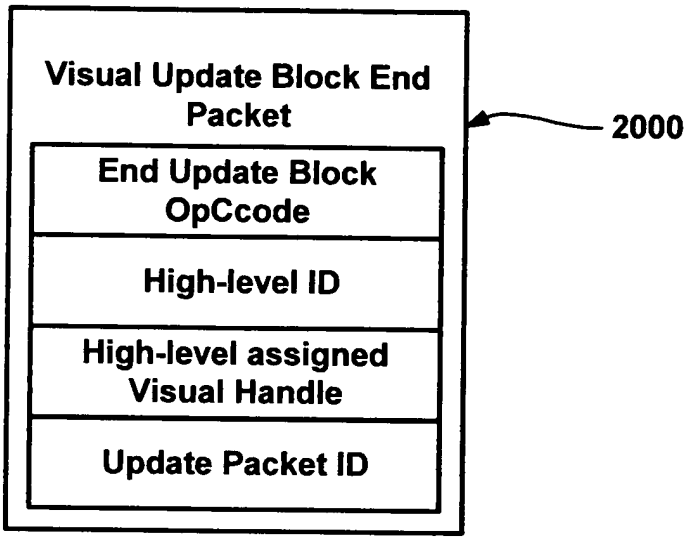
Visual Update Block End Packet
End Update Block OpCcode
High-level ID
High-level assigned Visual Handle
Update Packet ID
2000

FIG. 20

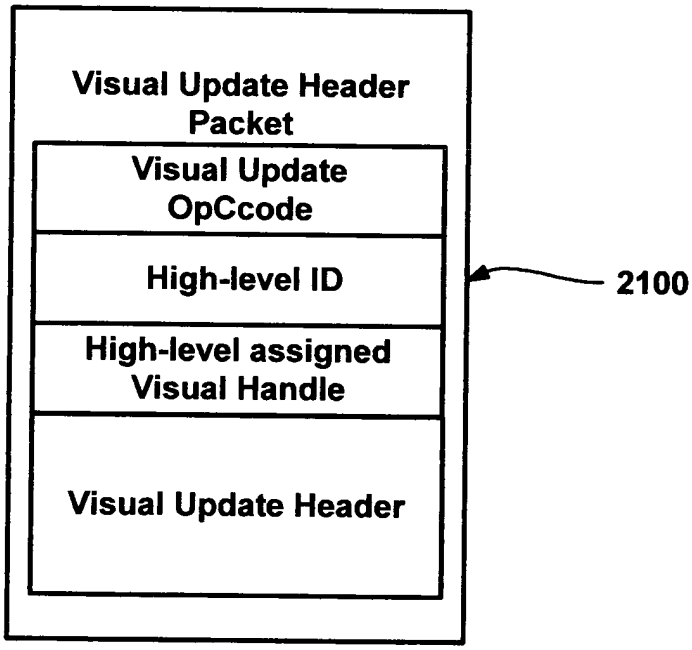
Visual Update Header Packet
Visual Update OpCcode
High-level ID
High-level assigned Visual Handle
Visual Update Header
2100

FIG. 21

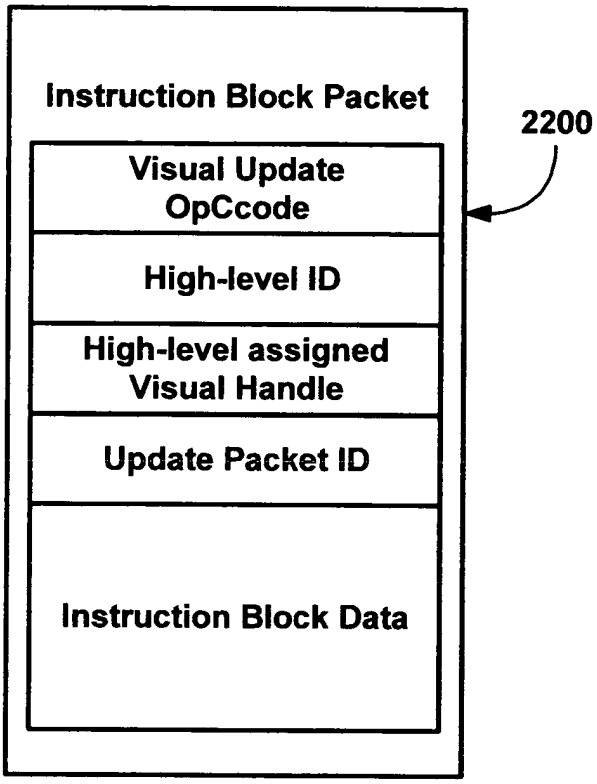
Instruction Block Packet
2200
Visual Update OpCcode
High-level ID
High-level assigned Visual Handle
Update Packet ID
Instruction Block Data

FIG. 22

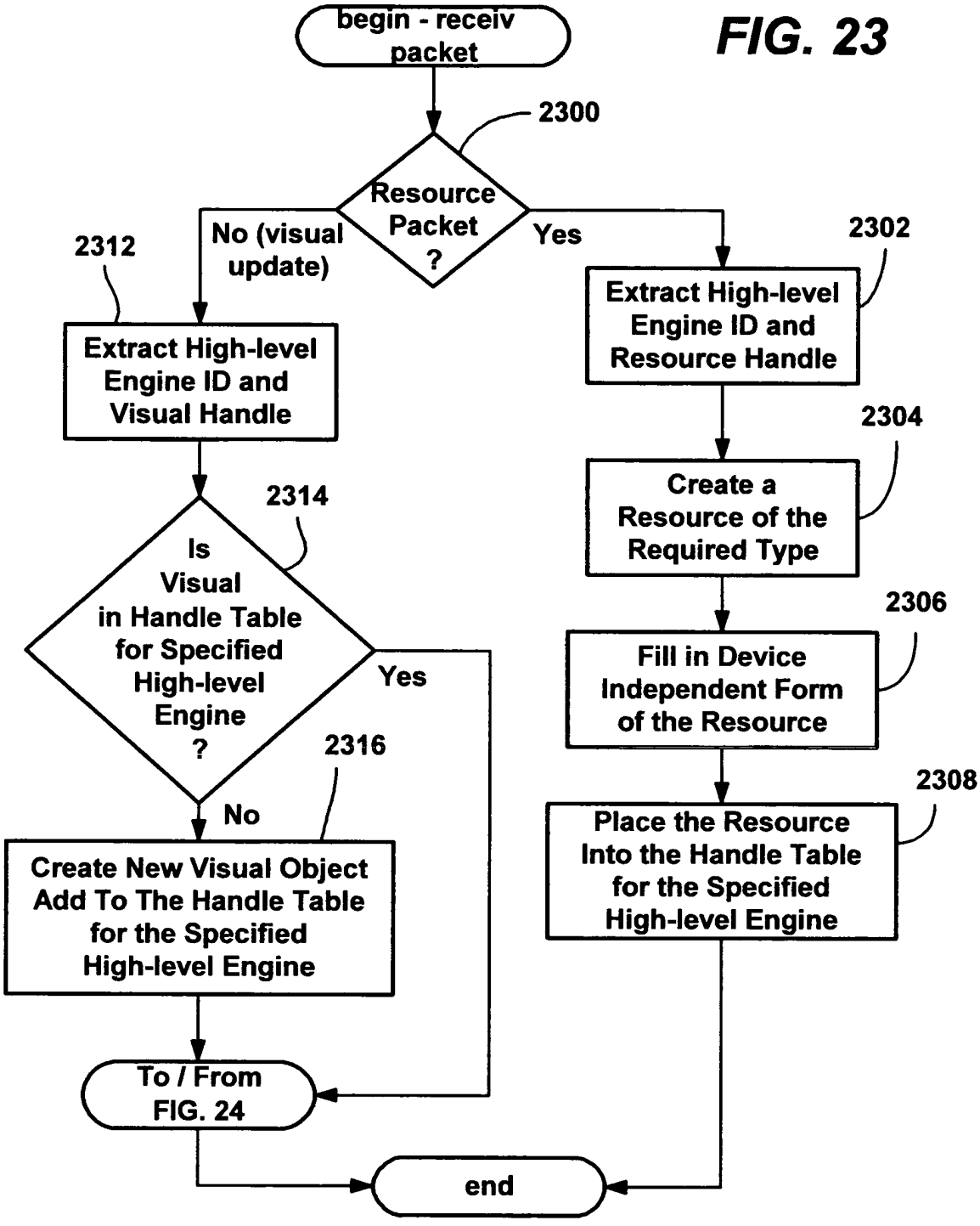
begin - receiv packet
2300
Resource Packet ?
No (visual update)
Yes
2312
2302
Extract High-level Engine ID and Visual Handle
Extract High-level Engine ID and Resource Handle
2304
Create a Resource of the Required Type
2314
Is Visual in Handle Table for Specified High-level Engine ?
Yes
2306
Fill in Device Independent Form of the Resource
2316
No
2308
Create New Visual Object Add To The Handle Table for the Specified High-level Engine
Place the Resource Into the Handle Table for the Specified High-level Engine
To / From FIG. 24
end

FIG. 23

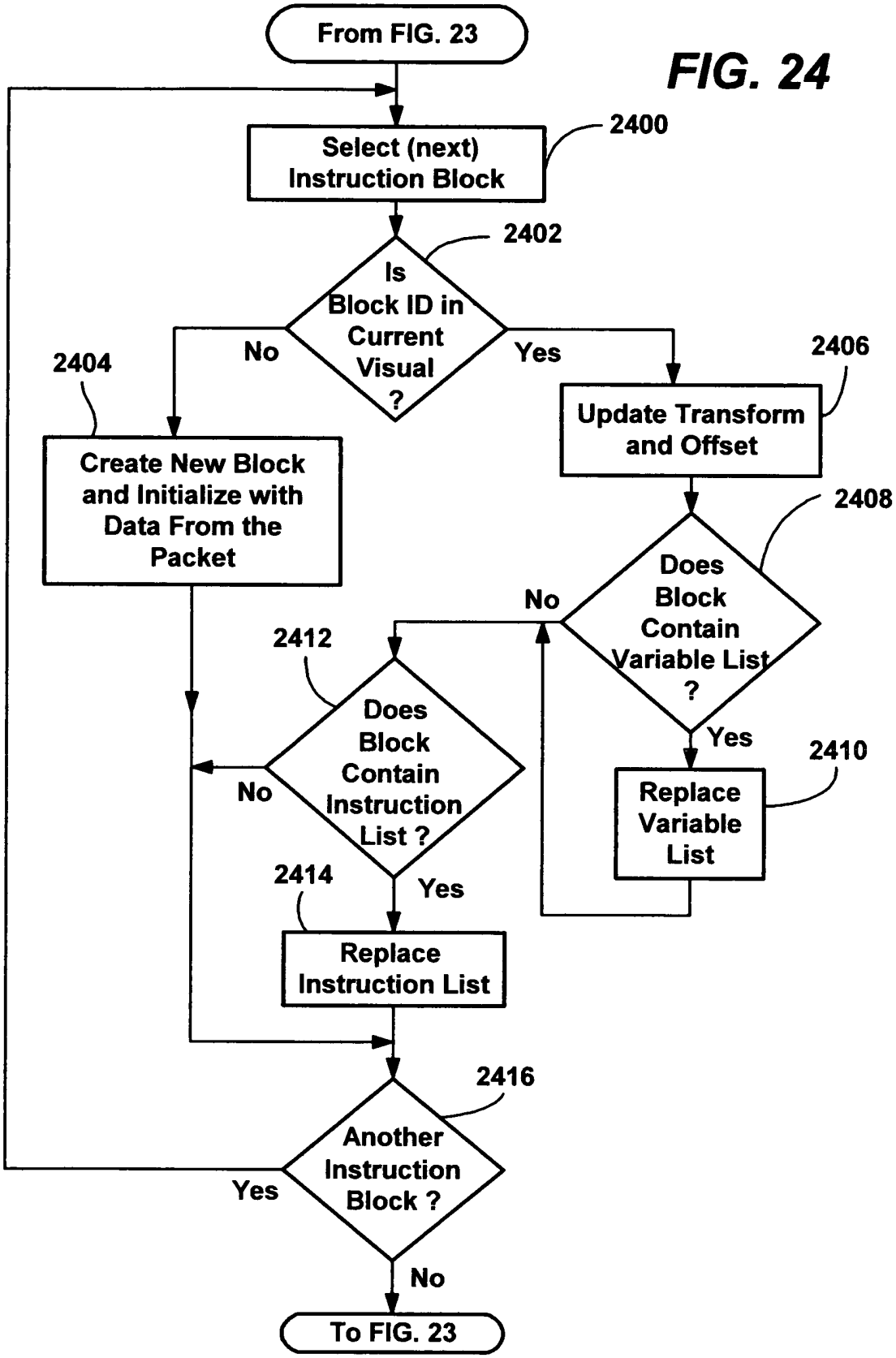
From FIG. 23
Select (next) Instruction Block
2400
Is Block ID in Current Visual ?
2402
No
Yes
2404
Create New Block and Initialize with Data From the Packet
2406
Update Transform and Offset
2408
Does Block Contain Variable List ?
No
Yes
2410
Replace Variable List
2412
Does Block Contain Instruction List ?
No
Yes
2414
Replace Instruction List
2416
Another Instruction Block ?
Yes
No
To FIG. 23

FIG. 24

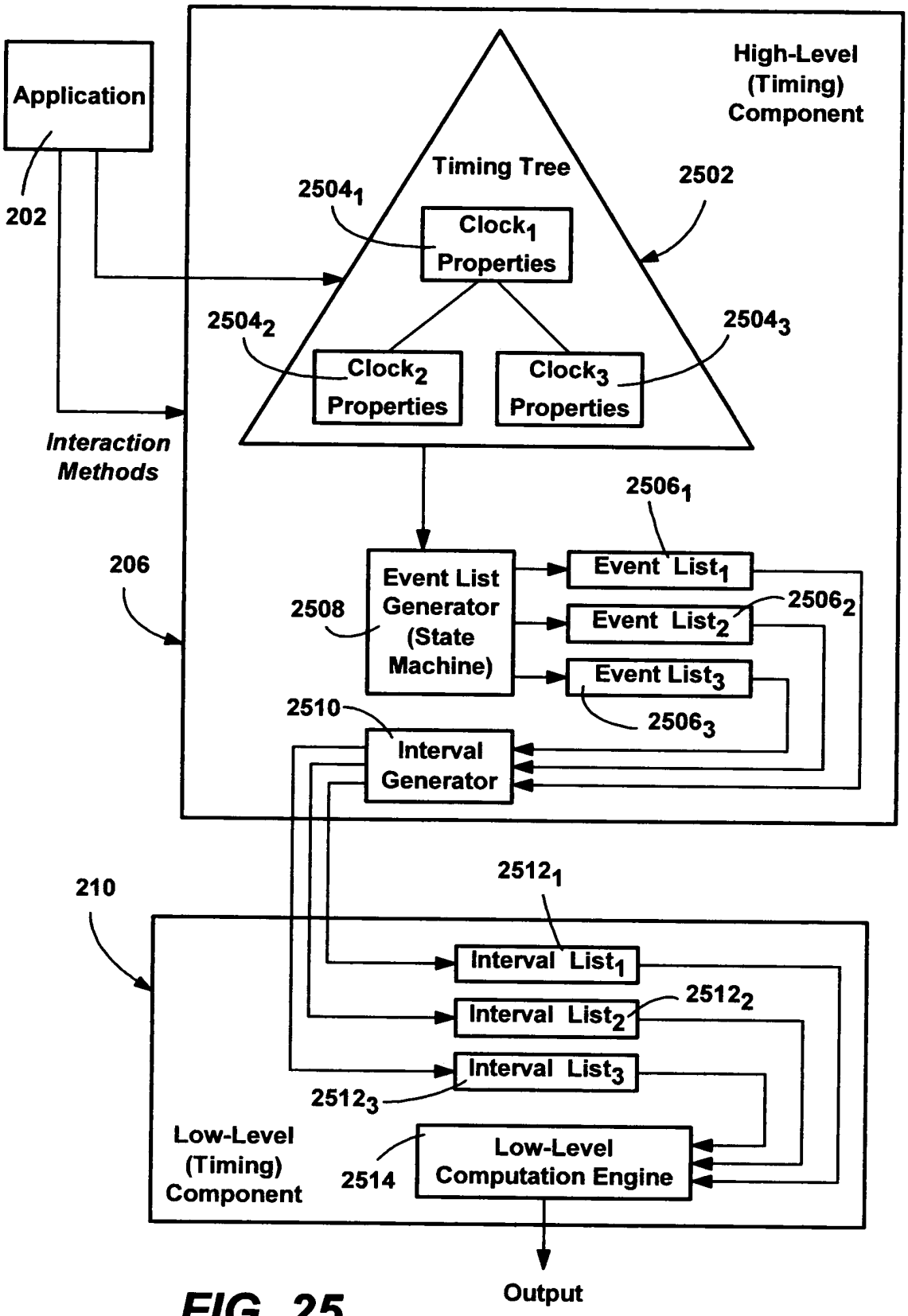
Application
202
High-Level (Timing) Component
Timing Tree
2502
2504$_1$
Clock$_1$ Properties
2504$_2$
2504$_3$
Clock$_2$ Properties
Clock$_3$ Properties
Interaction Methods
2506$_1$
206
Event List Generator (State Machine)
2508
Event List$_1$
Event List$_2$
2506$_2$
Event List$_3$
2506$_3$
2510
Interval Generator
210
2512$_1$
Interval List$_1$
Interval List$_2$
2512$_2$
Interval List$_3$
2512$_3$
Low-Level (Timing) Component
2514
Low-Level Computation Engine
Output

FIG. 25

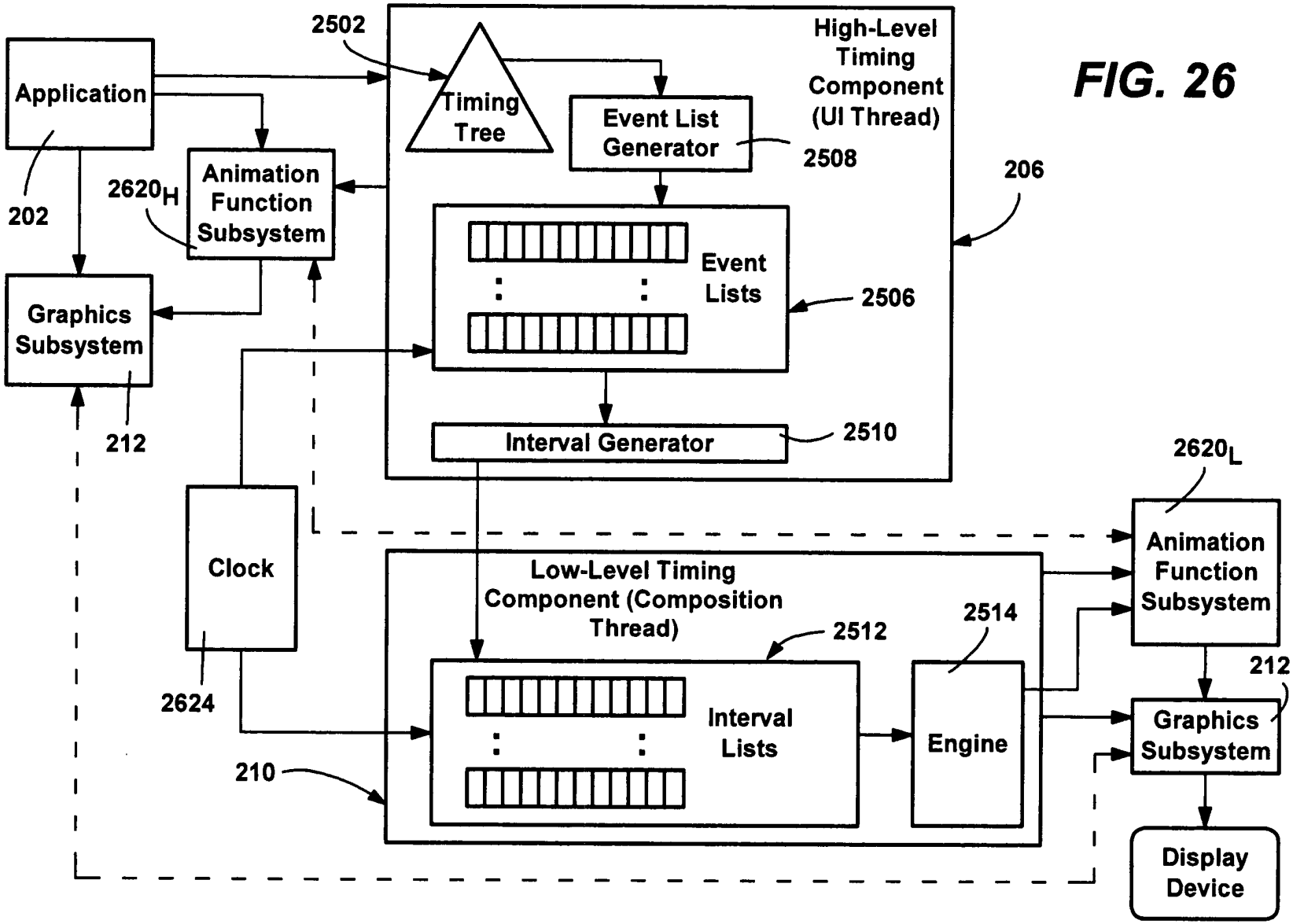
Application
202
Animation Function Subsystem
2620H
Graphics Subsystem
212
2502
Timing Tree
High-Level Timing Component (UI Thread)
Event List Generator
2508
206
Event Lists
2506
Interval Generator
2510
Clock
2624
Low-Level Timing Component (Composition Thread)
2512
2514
Interval Lists
Engine
210
2620L
Animation Function Subsystem
212
Graphics Subsystem
Display Device

FIG. 26

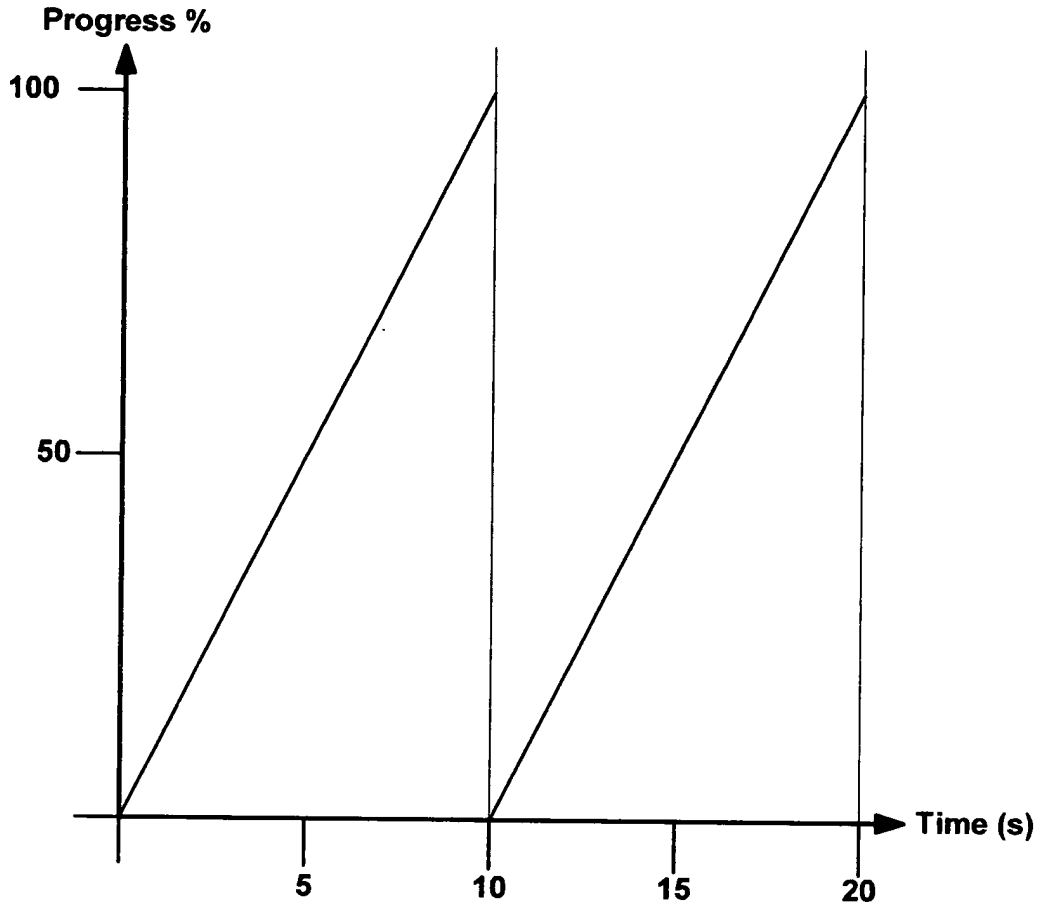

FIG. 27

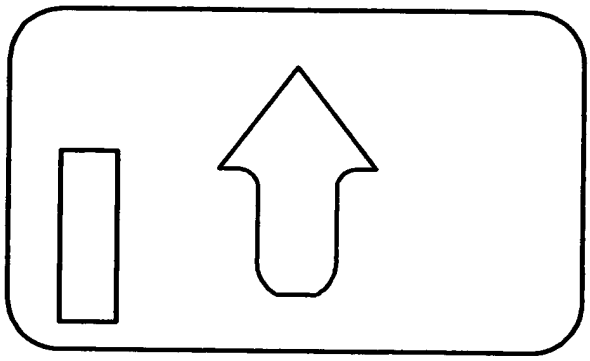

FIG. 28A

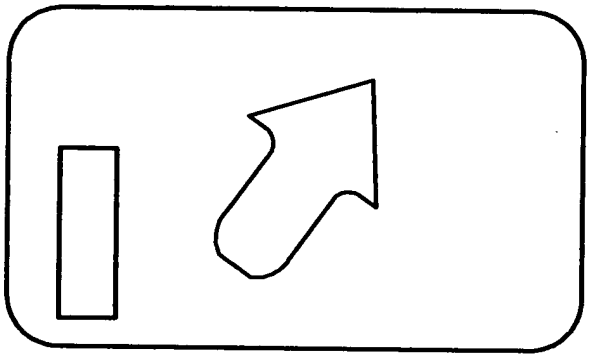

FIG. 28B

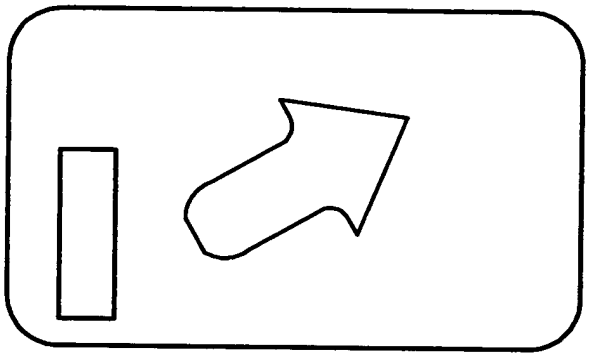

FIG. 28C

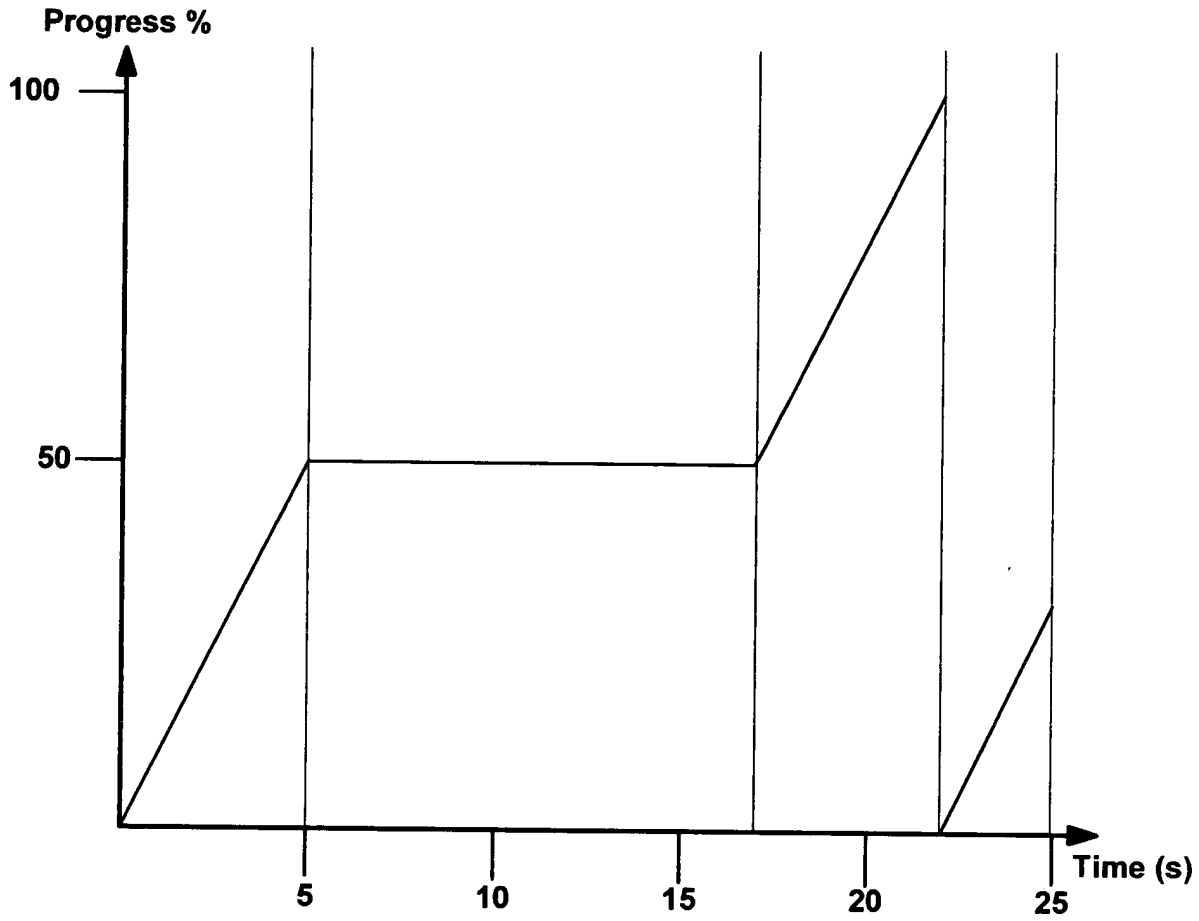

FIG. 29

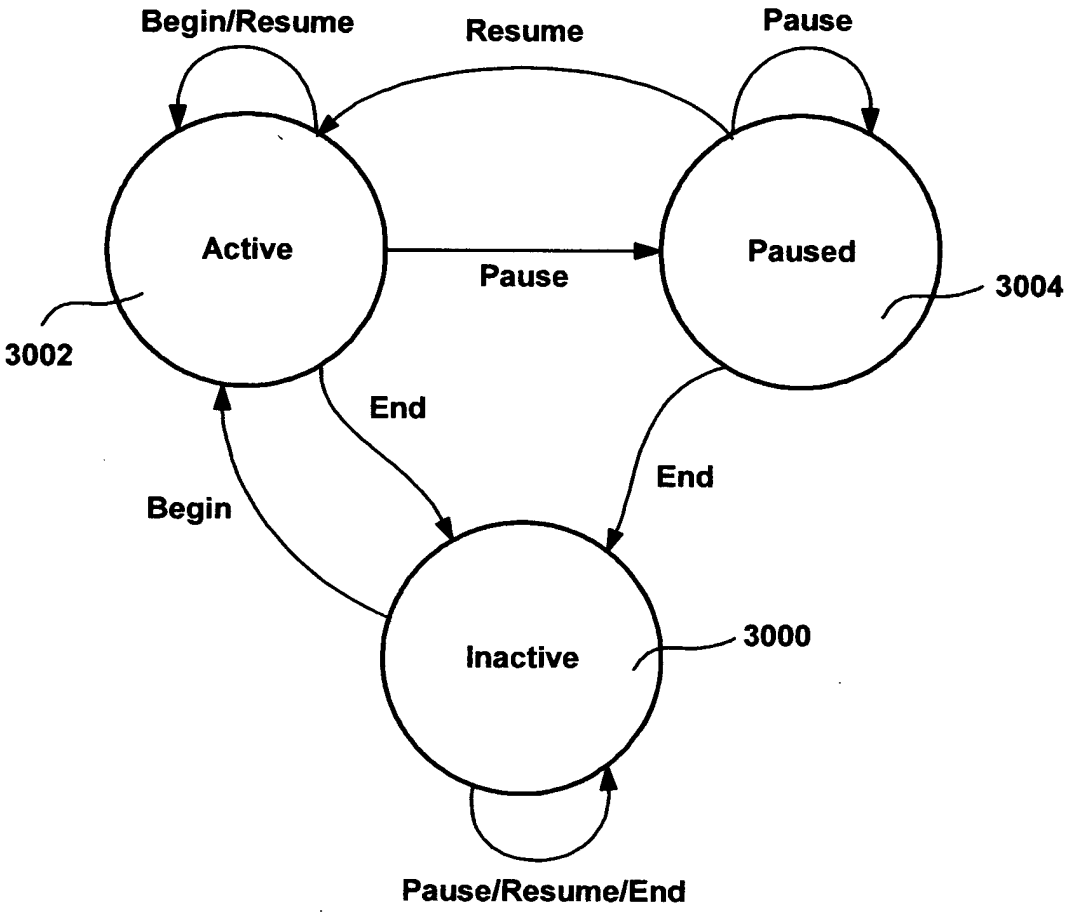
Begin/Resume
Resume
Pause
Active
Pause
Paused
3004
3002
End
End
Begin
Inactive
3000
Pause/Resume/End

FIG. 30

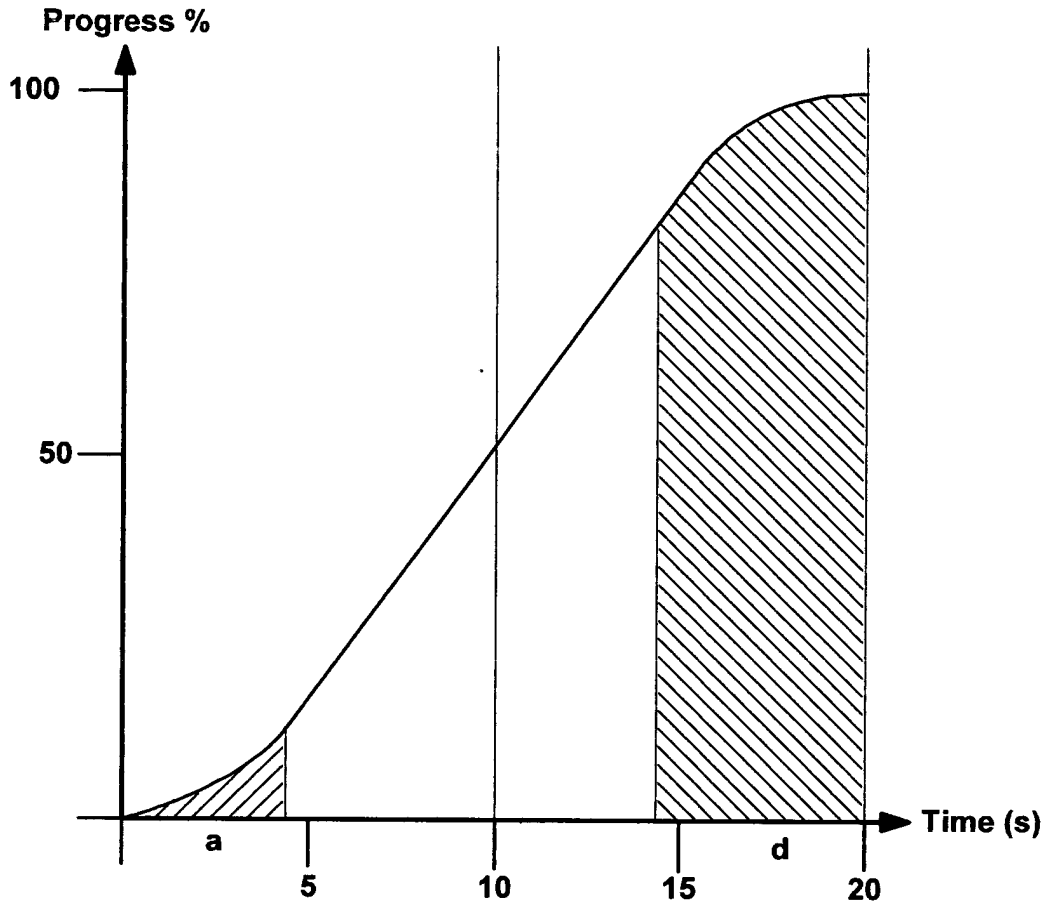

FIG. 31